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COMMONWEALTH OF AUSTRALIA

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Related Art	(56)	

The following statement is a full description of this invention, including the best method of performing it known to us :

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This invention relates to the formation of twisted strand assemblies and is applicable particularly, but not exclusively, to the formation of yarn from staple fibres, for example, wool fibres.

Our Australian Patent No. 260092 discloses a preparation of a yarn by converging a strand which has been twisted so that it has repeated along its length successive zones of opposite twist with another strand and allowing it to twist around that other strand. Both of the strands or all of them if there be more than two are intermittently twisted and converged with the regions of twist in the strand suitably phased so that, when the strands commence to untwist, they twist around each other and this plying of the strands restrains the twist in each individual strand to result in a self-stabilized plied assembly. Such an assembly will hereinafter, for the sake of convenience, be called a "self-twist" thread or, where appropriate, more specifically, a "self-twist yarn" and the individual components will be called "strands". Patent Specification No. 260092 particularly describes the production of "in phase" self-twist yarn in which two or more strands having alternating twist are converged with their zones of like twist in phase with one another and also the production of yarns in which two or more strands having alternating twist are converged with their like twist zones out of phase with one another, these latter types of yarn being referred to as "phased" yarns.

In the specification of our co-pending Australian Patent Application No. 51009/64 there are described a number of forms of apparatus for producing successive zones of opposite twist in textile strands and for performing the process of

Australian Patent No. 260092. Each of these forms of apparatus essentially comprises a pair of rollers which are arranged to form a nip and which are rotated at constant speed and simultaneously reciprocated transversely in opposite phase thereby to impart successive zones of opposite twist to a strand passing through the nip. The rollers are reciprocated with simple harmonic motion and therefore tend to generate a simple sinusoidal twist distribution in the strand travelling between them. The actual twist distribution imparted to the strand is, in fact, non-sinusoidal but is distorted due to variations in twisting efficiency with changing twist intensity. The twist distribution which the rollers tend to generate in the strand, i.e. ignoring variations in twisting efficiency with changing twist intensity, will hereinafter be referred to as the "theoretical" twist distribution.

The present invention provides apparatus which is essentially a varied form of the apparatus disclosed in Patent Specification No. 51009/64, the variation resulting in a modification of the usual approximately sinusoidal actual twist distribution imparted to the strands. It has been found to be advantageous to modify the twist distributions imparted by the oscillating twisting roller, particularly for the purpose of increasing the strength of the resultant yarn. The strength of an "in phase" self-twist yarn is dependent to a large extent on the rate of change of strand twist intensity at the "cross-over" regions of zero twist between the successive strand twist zones. The lower the rate of change of twist intensity, the longer is the length of yarn about each "cross-over" regions which has little twist and it is desirable in the production of "in phase" yarns to reduce these lengths of the little twist to

a minimum in order to produce a strong yarn. The obvious way to do this is simply to increase the peak twist intensity in the yarn so as to increase the amplitude of the twist distribution curve and also the rate of change of twist intensity at the zero twist regions. However, this involves higher roller reciprocating speeds and proportionally higher loadings on the roller drive mechanisms and, moreover, it will result in the greater part of the yarn having a much higher twist intensity than is necessary so that the yarn characteristics are subsequently altered. The present invention involves the modification of the twist distribution so that it is no longer a simple sinusoid, and, in one of its applications, enables the rate of change of twist intensity at the twist change-over regions to be increased without a corresponding increase in the maximum twist intensities.

According to the present invention, there is provided apparatus for twisting a travelling strand comprising twisting means operable to produce successive zones of opposite twist in the strand wherein the theoretical twist distribution which said means tends to impart to the strand departs from a simple sinusoidal distribution.

Said theoretical twist distribution may be a composite distribution formed by superimposing on a sinusoidal distribution of a fundamental frequency an additional sinusoidal distribution of frequency which is an harmonic of the fundamental frequency.

The theoretical twist distribution may be such that the rate of change of twist intensity at the regions of zero twist between said successive zones of opposite twist is greater than that for a simple sinusoidal twist distribution of the same maximum twist intensity.

The invention also provides a method of producing a stable twisted thread assembly comprising the steps of twisting a strand so that it has repeated along its length successive zones of opposite twist and converging the twisted strand with another strand and allowing the strands to twist around one another, wherein the first-said strand is twisted by means which tends to impart a twist distribution which departs from a simple sinusoidal distribution. The first-said strand may be passed through a first twisting device which tends to impart a sinusoidal twist distribution. of fundamental frequency and a second twisting device which tends to impart a twist distribution of a frequency which is an harmonic of the fundamental frequency.

The invention further provides a method of twisting a strand so that it has repeated along its length successive zones of opposite twist, comprising imparting to the strand a twist distribution which is a composite of at least two component regularly cyclic distributions one of which has a frequency which is an harmonic of the frequency of the other.

One type of apparatus according to the invention comprises a pair of surfaces arranged to form a nip between them and means to drive said surfaces forwardly and to reciprocate said surfaces transversely in opposite phase thereby to impart to the strand alternating zones of opposite twist, wherein the time variation of the miltiple of the speed of forward travel of each surface and the transverse speed of each surface departs from a simple sinusoidal variation.

A further type of apparatus according to the invention comprises two pairs of surfaces each arranged to form a nip, means to drive the surfaces of each pair forwardly at the same constant

speed, means to reciprocate one of the pairs of surfaces transversely in opposite phase at one frequency and means to reciprocate the other pair of surfaces in opposite phase at a frequency which is an harmonic of said one frequency.

In order that the invention may be more fully explained some embodiments thereof will now be described with reference to the accompanying drawings in which :-

Figure 1 is a diagrammatic sketch of an assembly of eccentric gears and concentric tears connected by chain drives and having means to accommodate variations in chain tension;

Figure 2 is a diagrammatic sketch of small concentric gear cycling within a stationary circular gear;

Figure 3 is a diagrammatic perspective view of two pairs of rotating and oscillating rollers operating in tandem; and

Figures 4, 5 and 6 depict exemplary twist distributions which may be achieved by means of apparatus constructed in accordance with the invention.

The devices shown in Figures 1 and 2 are designed to replace the connecting rod and drive crank mechanism of the roller twisting apparatus previously illustrated in Figures 2 to 6 of the aforesaid Australian Patent Specification No. 51009/64. Such replacement modifies the reciprocating motion of the twisting rollers so that the rollers pause near the ends of their stroke and have maximum speed of translation near the middle of their stroke.

In the device illustrated in Figure 1, a chain meshes

with an eccentric drive sprocket A and an eccentric driven sprocket B. The chain also meshes with idler sprockets C and F, sprocket C being mounted on a spring-loaded arm to compensate for tension changes in the chain. Gear A is rotated at constant angular speed in the direction shown and its varying driving radius causes the chain to trsvel at varying speed. This effect is increased by the varying driven radius of sprocket B. Sprocket D is concentric sprocket fixed on the same shaft as sprocket B and it drives a concentric sprocket E via a second chain. The teeth ratio of sprocket E to sprocket D is 2:1. A connecting rod G is connected at one end to sprocket E or to a disc fixed on the same shaft as sprocket E and is connected at its other end to the wheel 22 of the previously illustrated apparatus in place of the rod 24. The frequency of speed variations introduced by sprockets A and B is of twice the frequency of the rotation of sprocket E and appropriate timing between the two frequencies is chosen to obtain a desired twist distribution in the yarn.

The device illustrated in Figure 2 comprises a small concentric tear Y which meshes with a stationary internal ring gear Z, the gear ratio being 4:1. The small gear is rotatably mounted on a disc X which is disposed concentrically of the ring gear and is rotatable about its central axis. The connecting rod V to the drive wheel 22 of the oscillating rollers is connected to gear Y at position W and the motion of the oscillating rollers is the direct sum of the simple sinusoidal motion due to the rotation of the gear Y and the simple sinusoidal motion due to the rotation of the disc X. The

frequency of rotation of the gear Y is three times that of the disc X and the stroke due to gear Y is one tenth of that due to the disc X. The path followed by the end of the connecting rod which is connected to gear Y is shown in the figure as a broken line.

Instead of maintaining constant rotational speed of the twisting and drafting rollers and modifying their oscillating speed variation, the rollers could be oscillated sinusoidally and their rotational speeds varied by a sinusoidal or other frequency equal to the second harmonic of the frequency of oscillation of the roller. This could be achieved by means of elliptical gears or concentric gears or any differential gear device. The rotational speed of the twisting and drafting rollers could alternatively be modified by the device depicted in Figure 1. To this end, gear A could be driven at a frequency equal to twice the frequency of oscillation of the oscillating rollers and the output for rotating these rollers taken from concentric sprocket D, the forward speed of the yarn being relatively slow during changes of direction of the oscillating rollers and relatively fast midway between changes of direction.

The device illustrated in Figure 3 comprises two adjacent pairs of rotating and oscillating rollers L and M. The strand to be twisted passes successively through the nips between rollers L and rollers M which are rotated at the same constant speed. Each roller pair is essentially the same as that of Figures 2 to 6 of the aforesaid Specification No. 51009/64, rollers L being connected by flexible links to a wheel N and rollers M being connected in similar fashion to a wheel P.

Wheels N, P are reciprocated by cranks Q, R which are driven by a common drive shaft via gearing such that the frequency of oscillation of rollers M is the third harmonic frequency of that of rollers L. A convenient length of stroke of rollers M is one ninth of that of rollers L. The effect of this device is to superimpose two different cycle lengths of ratio 3:1 in one yarn or, considered from a different aspect, the approximately sinusoidal twist distribution generated by oscillating rollers L is modified by the action of rollers M. This effect is illustrated in Figure 4 which shows the theoretical twist distributions imparted by rollers L and M and the theoretical resultant twist distribution, each distribution being plotted as twist intensity (twist per unit length of strand against angular displacement of the oscillating rollers). The distribution represented by curve 1 is the theoretical twist distribution imparted by rollers L and that represented by curve m the distribution imparted by rollers M. Curve r is the algebraic sum of curves 1 and 2 and represents the resultant theoretical twist distribution imparted to the strand. It will be observed that the maximum twist intensity of curve 3 is less than that of curve 1 but the rate of change of twist intensity at its twist cross-over zones 4 is greater than the rate of change of twist intensity at the twist cross-over points in curve 1. An "in-phase" self-twist yarn produced by converging two strands each having the twist distributions as represented by curve 3 will therefore be stronger than a smaller yarn produced by converging two strands having sinusoidal twist distributions as represented by curve 1.

Figure 5 also represents twist distributions which may be achieved with the arrangement of Figure 3. It is similar to Figure 4 but in this case, the fundamental and third harmonic frequencies are phased such that the resultant theoretical distribution is approximately triangular. Figure 6 shows how two strands with triangular twist distribution as represented by curve r of Figure 5 may be self twisted to form an improved "phased" yarn. The triangular twist distribution in the strands before convergence are shown by the dotted lines and the resulting plied or self-twist distribution is shown by the full curve which is assumed to be the algebraic mean of the strand twists. This twist distribution has a greater rate of change of twist intensity at the zero twist regions than would be the case if two strands having sinusoidal twist distributions were converged with the same phasing.

The particular constructions which have been illustrated and described herein are given by way of example only and the invention is not limited thereto. For example, other non-sinusoidal distributions may result in desirable modifications in the yarn processing properties, yarn appearance, and the handling, appearance and general quality of any finished product made from the yarn quite apart from strength considerations.. It is therefore to be understood that the invention is in no way limited to the particular constructions and twist distributions described herein but includes many variations thereof within its spirit and scope as defined by the appended claims.

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The claims defining the invention are as follows:-

1. A method of twisting a strand so that it has repeated along its length successive zones of opposite twist, comprising imparting to the strand a twist distribution which is a composite of at least two component regularly cyclic distributions one of which has a frequency which is an harmonic of the frequency of the other. (18th August, 1967)

2. A method as claimed in claim 1, wherein the rate of change of twist intensity at the regions of zero twist between successive zones of opposite twist is greater than that for a simple sinusoidal twist distribution of the same maximum twist intensity. (18th August, 1967)

3. A method as claimed in claim 1 or claim 2, wherein said two component regularly cyclic distributions are substantially sinusoidal distributions.

(18th August, 1967)

4. A method as claimed in claim 3, wherein the frequency of one of the substantially sinusoidal twist distributions is a third harmonic of the frequency of the other.

(18th August, 1967)

5. A method as claimed in any one of claims 1 to 3, wherein the said strand is passed through a first twisting device which imparts one of the component regularly cyclic twist distributions and then through a second twisting device which imparts the second component cyclic twist distribution.

(18th August, 1967)

6. A method of producing a stable twisted thread assembly comprising the steps of twisting a strand by a method as claimed in any one of claims 1 to 4, and converging the twisted strand with another strand and allowing the strands to twist around one another. (18th August, 1967)

7. A method of producing a stable twisted thread assembly comprising the steps of twisting a strand so that it has repeated along its length successive zones of opposite twist and converging the twisted strand with another strand and allowing the strands to twist around one another, wherein the first-said strand is twisted by means which tends to impart a twist distribution which departs from a simple sinusoidal distribution. (18th August, 1967)

8. A method as claimed in claim 7, wherein the rate of change of twist intensity at the regions of zero twist between said successive zones of opposite twist is greater than that for a simple sinusoidal twist distribution of the same maximum twist intensity. (18th August, 1967)

9. A method of producing a stable twisted thread assembly substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings. (18th August, 1967)

10. A method of producing a stable twisted thread assembly substantially as hereinbefore described with reference to Figures 5 and 6 of the accompanying drawings.

(18th August, 1967)

11. Apparatus for twisting a travelling strand, comprising twisting means operable to produce successive zones of opposite twist in the strand wherein the theoretical twist distribution

which said means tends to impart to the strand departs from a simple sinusoidal distribution. (18th August, 1967)

12. Apparatus as claimed in claim 11, wherein said theoretical twist distribution is a composite distribution formed by superimposing on a sinusoidal distribution of one frequenzy an additional sinusoidal distribution of a frequency which is an harmonic of the fundamental frequency.

(18th August, 1967)

13. Apparatus as claimed in claim 11 or claim 12, wherein the theoretical twist distribution is such that the rate of change of twist intensity at the regions of zero twist between successive zones of opposite twist is greater than that for a simple sinusoidal twist distribution of the same maximum twist intensity. (18th August, 1967)

14. Apparatus for twisting a travelling strand, comprising a pair of surfaces arranged to form a nip between them and means to drive said surfaces forwardly and to reciprocate said surfaces tranversely in opposite phase thereby to impart to the strand alternating zones of opposite twist, wherein the time variation of the multiple of the speed of forward travel of each surface and the transverse speed of each surface departs from a simple sinusoidal variation. (18th August, 1967)

15. Apparatus as claimed in claim 14, wherein said time variation is a composite of at least two component regularly cyclic variations one of which has a frequency which is an harmonic of the frequency of the other.

(18th August, 1967)

16. Apparatus as claimed in claim 15, wherein said component variations are sinusoidal.

(18th August, 1967)

17. Apparatus as claimed in claim 16, wherein the frequency of one sinusoidal variation is the third harmonic of the frequency of the other sinusoidal variation.

(18th August, 1967)

18. Apparatus as claimed in any one of claims 14 to 17, wherein the twisting surfaces are defined by a pair of oppositely rotated transversely reciprocating rollers.

(18th August, 1967)

19. Apparatus as claimed in claim 18, wherein the rollers are rotated at constant speed and are reciprocated by reciprocatory drive means such as to provide said time variation.

(18th August, 1967)

20. Apparatus as claimed in claim 19, wherein the reciprocatory drive means comprises a crank mechanism connected to the rollers by means of a pair of flexible links arranged to be reciprocated simultaneously and in opposite phase by the said crank mechanism, and crank mechanism drive means operable to generate, via the crank mechanism and the links, said time variation.

(18th August, 1967)

21. Apparatus for imparting twist to a travelling strand comprising two pairs of surfaces each arranged to form a nip, means to drive the surfaces of each pair forwardly and at the same constant speed, means to reciprocate one of the pairs of surfaces tranversely in opposite phase at a first frequency and means to reciprocate the other pair of surfaces in opposite

phase at a frequency which is an harmonic of the first frequency. (18th August, 1967)

22. Apparatus as claimed in claim 21, wherein the second frequency is a third harmonic of the first frequency. (18th August, 1967)

23. Apparatus as claimed in claim 21 or claim 22, wherein each pair of twisting surfaces are defined by a pair of oppositely rotated transversely reciprocating rollers. (18th August, 1967)

24. Apparatus as claimed in claim 23, wherein each pair of rollers is reciprocated by means of a crank mechanism connected thereto by means of a pair of flexible links arranged to be reciprocated simultaneously and in opposite phase of said crank mechanism. (18th August, 1967)

25. Apparatus substantially as hereinbefore described with reference to any one of Figures 1 to 3 of the accompanying drawings. (18th August, 1967)

26. The parts, elements, steps and features referred to or indicated in the specification and/or claims and/or drawings of this application, individually or collectively and any and all combinations of any two or more of said parts, elements, steps or features.

DATED THIS 21ST DAY OF JUNE, 1968

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

By its Patent Attorneys,
DAVIES & COLLISON

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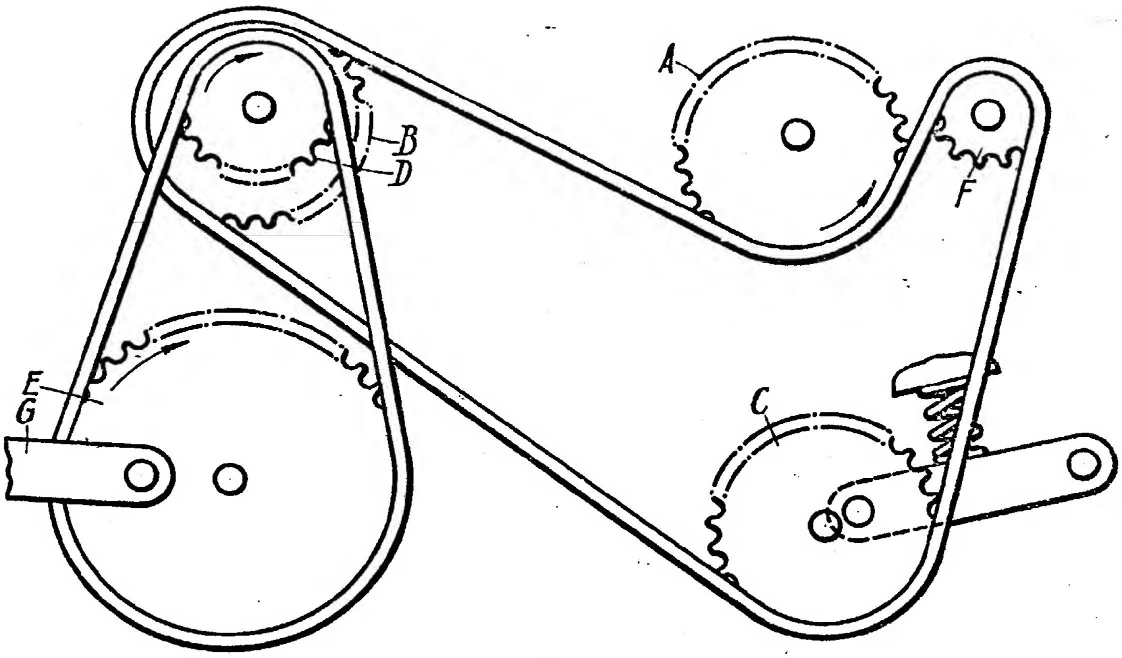

Fig. 1

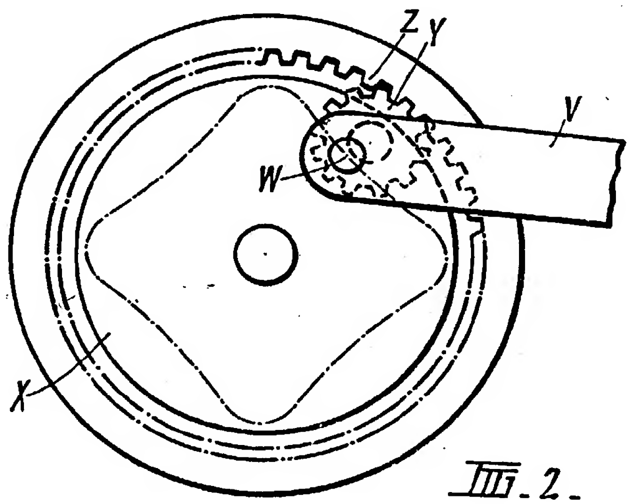

Fig. 2

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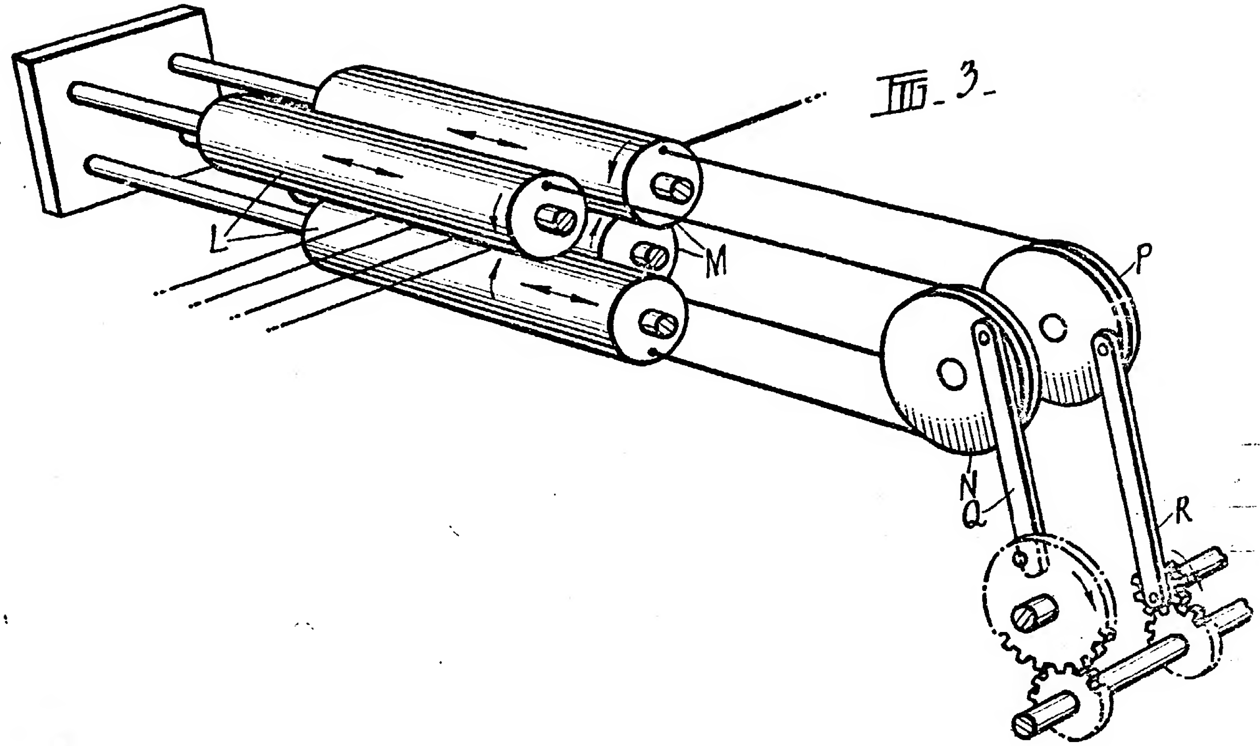

Fig. 3

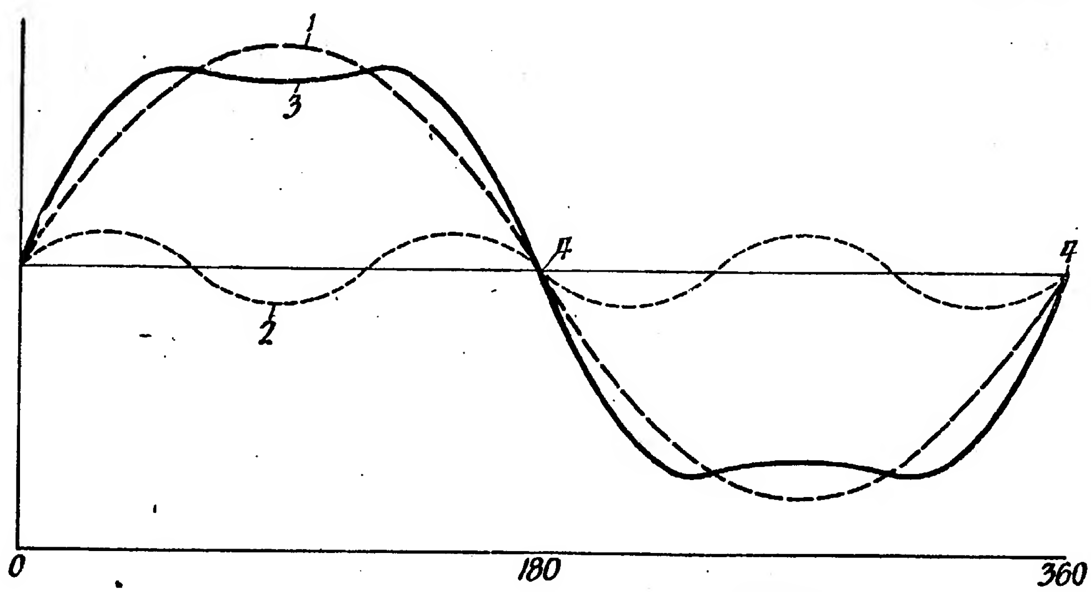

Fig. 4

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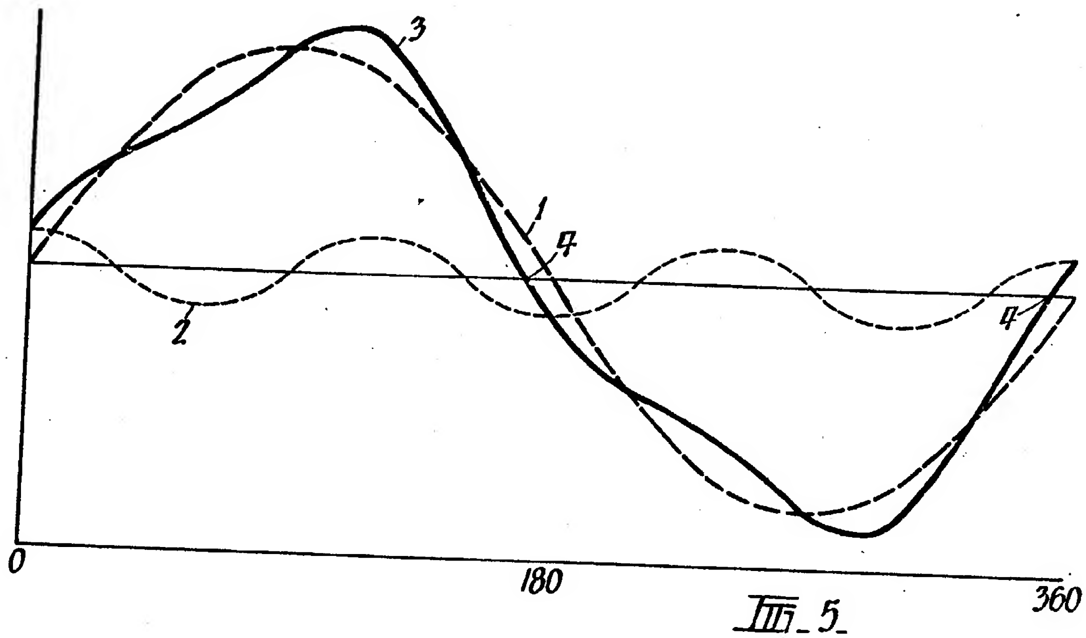

Fig_5_

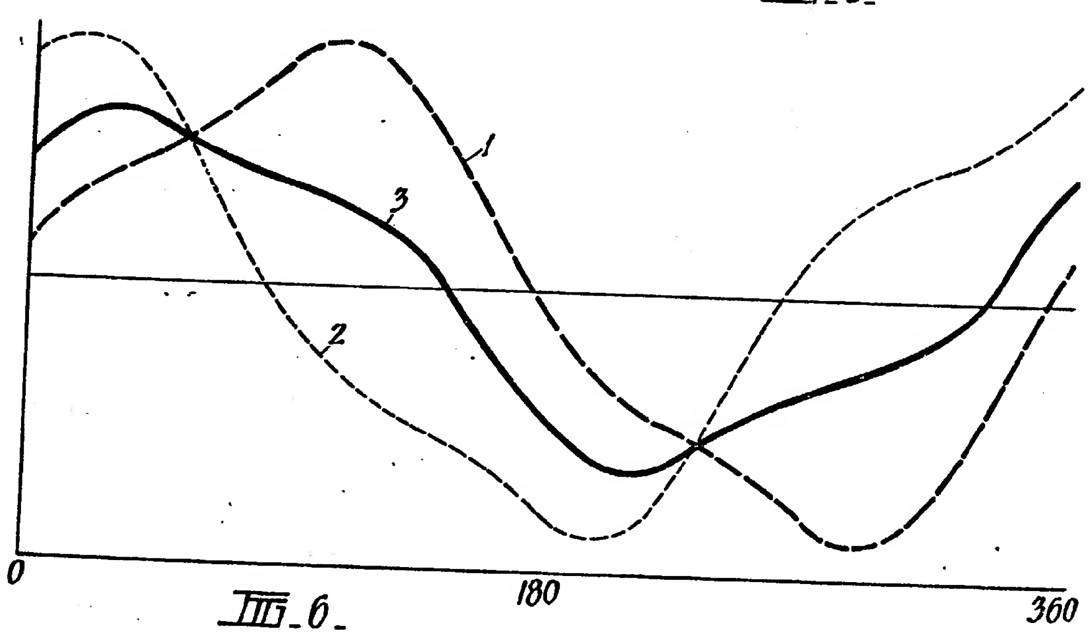

Fig_6_